

A New Species of *Aeolidiella* Bergh, 1867 (Mollusca: Nudibranchia: Aeolidiidae) from the Florida Keys, USA

ÁNGEL VALDÉS

Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, USA.

E-mail: avaldes@nhm.org

Abstract. A new species of *Aeolidiella* is described based on specimens collected from the Florida Keys. The species is characterized by having a translucent gray color, with opaque white pigment on the rhinophores, oral tentacles, and most of the dorsum except for the head, where the white pigment forms a triangular patch. External and internal differences separate this species from other members of the genus. It is possible that this species is bred for aquarium control of species of *Aiptasia*, and commercialized under the name *Berghia verrucicornis*.

INTRODUCTION

Members of the family Aeolidiidae differ from other aeolidacean nudibranchs in having pectinate rather than cuspidate radular teeth (Rudman, 1982; Gosliner, 1985; Miller, 2001). The number of valid genera within the Aeolidiidae has been the subject of controversy. Gosliner (1985) recognized ten valid genera: *Aeolidia* Cuvier, 1798, *Spurilla* Bergh, 1864, *Aeolidiella* Bergh, 1867, *Cerberilla* Bergh, 1873, *Berghia* Trinchese, 1877, *Baeolidia* Bergh, 1888, *Protaeolidiella* Baba, 1955, *Aeolidiopsis* Pruvot-Fol, 1956, and *Plenrolidia* Burn, 1966, distinguished by the position of the anus and the nephroproct, the radular formula, the arrangement of the cerata, and the morphology of the rhinophores. Rudman (1982) considered that *Berghia* is a synonym of *Spurilla*, because of the lack of anatomical differences other than the rhinophore morphology, and Rudman (1990) synonymized *Plenrolidia* with *Protaeolidiella*. More recently, Miller (2001) proposed a new and more complex classification in which *Berghia* and *Spurilla* are maintained separate and two new genera—*Anteaeolidiella* Miller, 2001 and *Burnaia* Miller, 2001—are introduced. The diagnoses of Miller's genera are more detailed than those by Gosliner (1985) and include characters of the digestive system, such as the ramification of the digestive gland and the morphology of the oral glands. No phylogenetic hypothesis supports any of these proposed classifications and the relationships between members of this group are in need of revision.

Nine valid species of Aeolidiidae belonging to the genera *Berghia*, *Linenandra*, *Spurilla*, *Aeolidiella*, and *Cerberilla* are represented in the tropical West Atlantic (Marcus, 1977). Recent fieldwork in the Florida Keys has revealed the presence of a new species of Aeolidiidae, which is described in the present note. The material examined is deposited at the Natural History Museum of

Los Angeles County (LACM) and the Zoologisk Museum, Københavns Universitet, Copenhagen (ZMUC). Newly collected specimens were relaxed in magnesium chloride 10% and subsequently preserved in ethanol 70%.

SPECIES DESCRIPTION

AEOLIDIIDAE Gray, 1827

Aeolidiella Bergh, 1867

Aeolidiella stephanieae Valdés, sp. nov.

(Figures 1–3)

Type material: Holotype: Shore in front of the Bayside Resort (mile marker 99.5) (25°05'27"N, 80°26'28"W), Key Largo, Monroe County, Florida, 13 July 2003, 1–2 m depth, 5 mm preserved length, leg. S. Knowles and A. Valdés (LACM 3014). Paratypes: Shore in front of the Bayside Resort (mile marker 99.5) (25°05'27"N, 80°26'28"W), Key Largo, Monroe County, Florida, 22 July 2003, 1–2 m depth, 3 specimens, 4–7 mm preserved length, leg. S. Knowles and A. Valdés (LACM 3015).

External morphology: The body is elongate (Figure 1), wider anteriorly, reaching 7 mm in preserved length. The foot corners are triangular and elongate (Figure 2A). The oral tentacles are about twice as long as the rhinophores in the living animals. The rhinophores bear about 6–10 inconspicuous lamellae, situated only on the distal half and surrounding the entire surface of the rhinophore (Figures 1, 2D). The cerata are arranged in straight rows (Figure 2E), divided into groups separated by narrow gaps lacking cerata. Within each group the rows are equidistant, with the shorter cerata situated more ventrally and dorsally. The first group of cerata contains 5 rows and the genital opening is situated ventrally to the second and third rows. The second and third groups contain 4 rows of cerata, larger than those in the first group. The cardiac

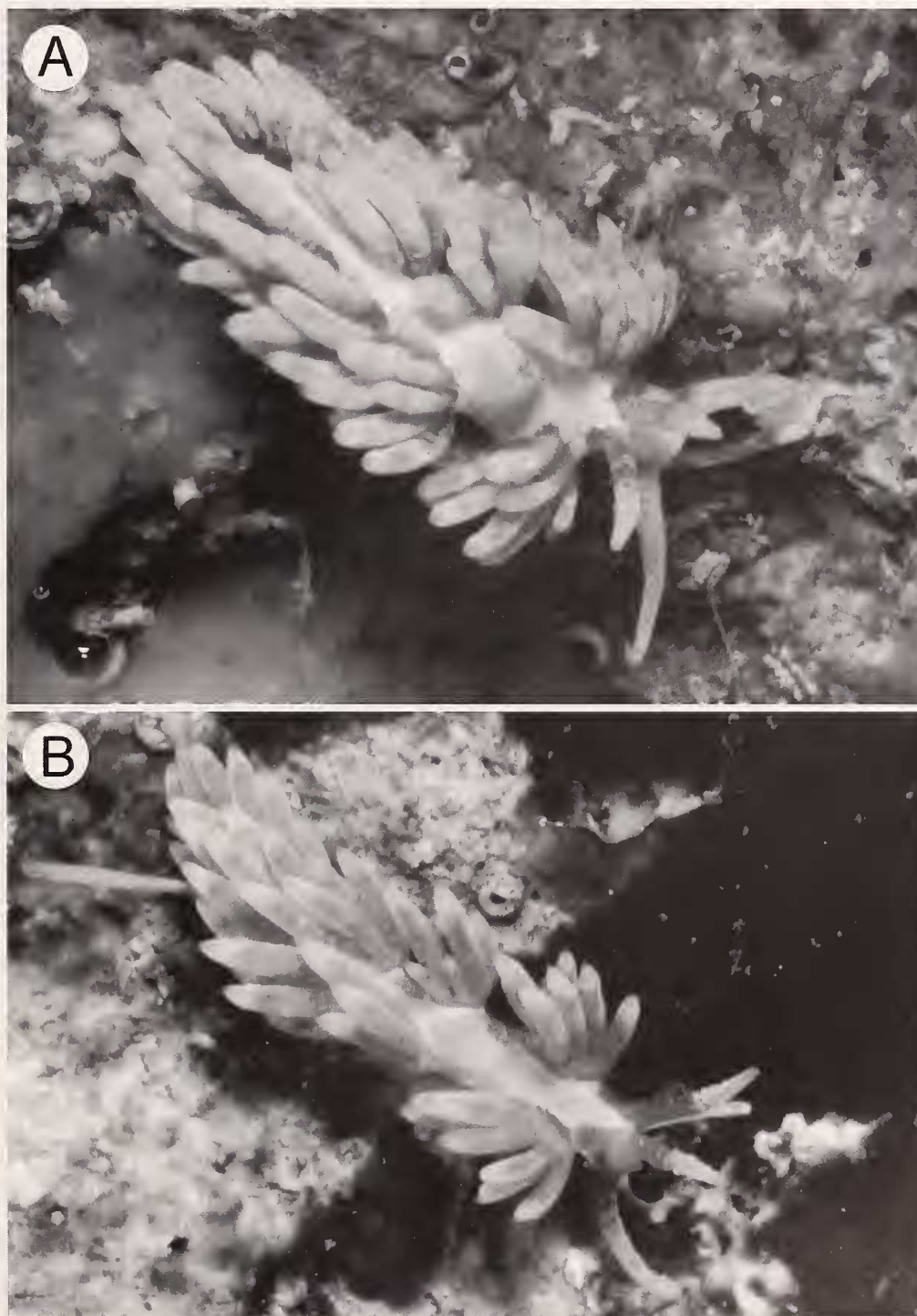


Figure 1. *Aeolidiella stephanieae* sp. nov., living animals. A, Paratype (LACM 3015). B, Holotype (LACM 3014).

area is situated between the first and second groups. The anus is cleioproctic, situated beneath the third group of cerata. The nephroproct is situated anterior to the anus. The last 7 rows of cerata are clustered all together in the

same group that contains some of the largest cerata. Each ceras contains an extension of the digestive gland and an oval cnidosac at the apex (Figure 2B).

The color of the living animals is translucent gray, with

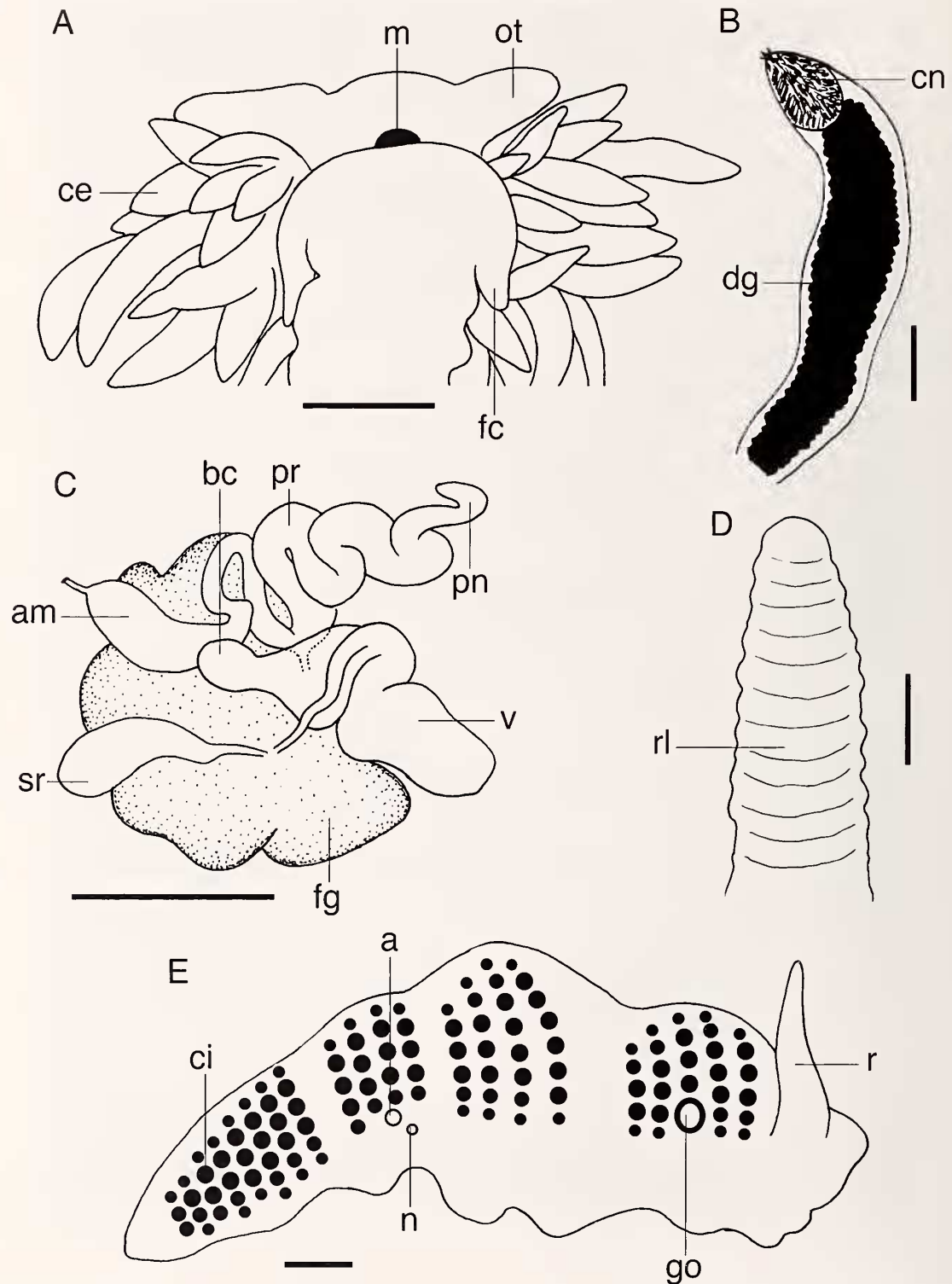


Figure 2. *Acolidiella stephanieae* sp. nov., anatomy of a paratype (LACM 3015). A, Ventral view of the mouth area, scale bar = 1 mm. B, Ceras, scale bar = 1 mm. C, Reproductive system, scale bar = 1 mm. D, Preserved rhinophore, scale bar = 1 mm. E, Arrangement of the cerata, genital aperture, anus and nephroproct in the preserve specimen, scale bar = 2 mm. Abbreviations: a, anus; am, ampulla; bc, bursa copulatrix; ce, ceras; ci, ceras insertion; cn, cnidosac; dg, digestive gland; fc, foot corner; fg, female glands; go, gonopore; m, mouth opening; n, nephroproct; ot, oral tentacle; pn, penis; pr, prostate; r, rhinophore; rl, rhinophoral lamella; sr, seminal receptacle; v, vagina.

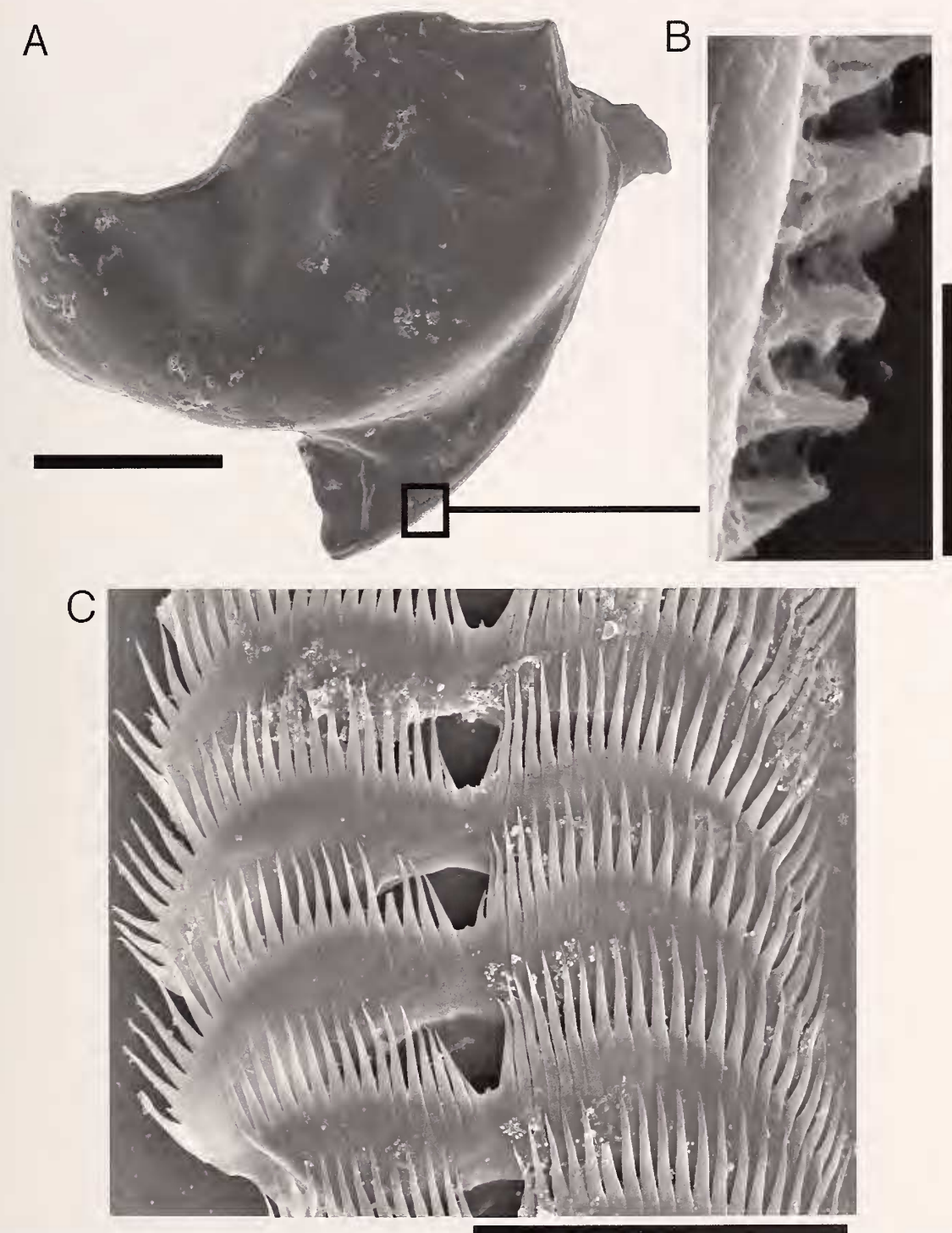


Figure 3. *Aeolidiella stephanieae* sp. nov., scanning electron micrographs of a paratype (LACM 3015). A, Jaw, scale bar = 500 μm . B, Detail of the jaw masticatory border, scale bar = 3 μm . C, Radular teeth, scale bar = 100 μm .

opaque white pigment on the distal half of the rhinophores and oral tentacles, and the entire dorsum except for the head, where the white pigment forms a triangular patch that ends behind the eyespots. The jaws are visible as two light brown patches on both sides of the head. There are a few opaque white spots on the base of the oral tentacles are rhinophores as well as the sides of the body. The cerata are grayish with diffuse white pigment on the proximal $\frac{2}{3}$ and an entirely opaque white distal $\frac{1}{3}$, with a slight orange tinge in some specimens.

Internal anatomy: The reproductive system is diaulic (Figure 2C). The ampulla is long and slightly curved; it narrows into the hermaphrodite duct before connecting to the female glands and the prostate. The prostate is long and convoluted, narrowing into a long and curved penis. There is no penial armature. The vagina is wide and convoluted; at its mid-length it divides into a long duct that connects to the female glands and a wider and curved duct that ends in a small and rounded bursa copulatrix. There is a large seminal receptacle connected to the female glands.

The radular formula is $22 \times 0.1.0$. The radular teeth are pectinate, with a concave base and a central cusp reduced to a small, triangular denticle (Figure 3C). There are 20–25 long and pointed denticles on each side of the cusp. The innermost denticles are shorter, becoming longer towards the laterals of the teeth and shorter again near the outermost edge. The jaws are oval in shape (Figure 3A). The masticatory border of the jaws has several irregular denticles (Figure 3B).

Etymology: This species is named in honor of Stephanie Knowles, for her invaluable assistance, enthusiasm, and support during the fieldwork in the Florida Keys.

DISCUSSION

This new species is here placed in *Aeolidiella* following the diagnosis of Gosliner (1985) who defined this group by the presence of a cleiproct anus, cerata arranged in linear rows, and nephroproct preanal. The reproductive system of *Aeolidiella stephanieae* sp. nov. also resembles that of *Aeolidiella indica* Bergh, 1888 (described by Gosliner, 1985) in having both a bursa copulatrix and a seminal receptacle. Miller (2001) introduced the new monotypic genus *Autaeolidiella*, type-species *Aeolidiella indica*, which according to this author differs from *Aeolidiella* in having a forked arrangement of the lateral ducts of the digestive gland, evenly tapered body, high bilobed radular tooth with a reduced cusp, and nodulose oral glands. The anatomical characteristics of *Aeolidiella stephanieae* sp. nov. are more similar to those of *A. indica* than to those of *Aeolidiella soemmeringi* (Leuckart, 1828) [synonym: *Aeolidiella alderi* (Cocks, 1852)], the type-species of *Aeolidiella*, which has a broader body, with the rows of cerata leaving no gaps, and radular teeth with a

large central cusp. Following the classification and ideas proposed by Miller (2001), *A. stephanieae* sp. nov. would probably belong in *Autaeolidiella* or in its own distinct genus. Miller's (2001) scheme includes stricter diagnoses for genera (based on numerous characters), and consequently he recognizes more taxa than in previous classifications. It is questionable whether such a large number of genera, several of which are monotypic, reflect the diversification that took place in this group. For the purposes of the present paper, *A. stephanieae* sp. nov. will be provisionally placed in the genus *Aeolidiella* until a phylogenetic hypothesis for the group becomes available.

The only two valid species of *Aeolidiella* described from the Caribbean are *Aeolidiella occidentalis* Bergh, 1874, only known from St. Thomas, Virgin Islands, and *Aeolidiella lurana* Marcus & Marcus, 1967, originally described from Brazil (Marcus & Marcus, 1967) and subsequently reported from Curaçao and Puerto Rico (Marcus & Marcus, 1970).

Aeolidiella occidentalis Bergh, 1874 was described on the basis of preserved specimens collected by Krebs in 1853 and deposited at ZMUC for several years. The color of the living animals is unknown, but the anatomy was partially studied and described by Bergh (1874). The preserved specimens had white lines on the dorsum and white spots on the cerata, head and dorsum, very different from the single wide white line on the dorsum of *Aeolidiella stephanieae* sp. nov., which also lacks white spots on the cerata, dorsum, and head. The most notable differences between these two species are the shape of the radular teeth, which are more convex, have shorter denticles and a more developed cusp in *A. occidentalis* and the presence of denticles on the masticatory border of the jaws of *A. stephanieae* sp. nov. According to Marcus & Marcus (1967), the systematic position of *A. occidentalis* is problematic. The location of the anus of this species, "somewhat farther in front than in most true Aeolidiidae, disagree with the characters known for *Aeolidiella*." Bergh (1874) described the presence of circular or oblique folds on the rhinophores, similar to the lamellae of *A. stephanieae* sp. nov., but it is impossible to determine whether this is an artifact of preservation or real lamellae. Examination of the two remaining syntypes of *A. occidentalis* ZMUC (GAS-2042) revealed no additional information, so this species is unidentifiable.

Aeolidiella lurana is characterized by having smooth rhinophores, a background bluish white color with pink pigment on the oral tentacles and the sides of the head and yellow on the dorsum, the middle of the head and the distal part of the rhinophores (Marcus & Marcus, 1967). The cerata are orange with dark brown nodular diverticula. This is very different from *Aeolidiella stephanieae* sp. nov., which is a species with annulated tubercles and a grey background color with opaque white pigment on the oral tentacles, rhinophores and dorsum. Other differences between these two species include the

morphology of the radular teeth, which are proportionally wider and shorter in *A. stephanieae* sp. nov. and the position of the anus, which is located between the first and second group of cerata in *A. lurana* and beneath the third group in *A. stephanieae* sp. nov.

Eastern Atlantic species of *Aeolidiella* are *Aeolidiella alderi* (Cocks, 1852), *Aeolidiella glauca* (Alder & Hancock, 1845) and *Aeolidiella sanguinea* (Norman, 1877). These three species have smooth rhinophores, continuous rows of cerata, not separated by gaps, and other consistent color differences with *Aeolidiella stephanieae* sp. nov. (see Thompson & Brown, 1984).

Kempf (2002) posted a photograph of a single specimen of *Aeolidiella stephanieae* collected from an undetermined locality in the Florida Keys. The coloration of this specimen is very similar to the material here examined, with the exception of the presence of slightly browner cerata due to the short-term, temporary storage of zooxanthellae after feeding. Kempf (2002) indicates that this species is bred for aquarium control of species of *Aiptasia*, but no other information or illustrations of commercial specimens is provided, so it is not possible to determine whether this species is being artificially bred. No other references to this species have been found in the literature.

Lindsey Groves (LACM) curated the specimens collected and critically reviewed the manuscript. This manuscript is based upon work supported by the National Science Foundation under Grant No. 0216506.

LITERATURE CITED

- BERGH, R. 1874. Beiträge zur Kenntniss der Aeolidiaden. II. Verhandlungen der kaiserlich-königlichen zoologische-botanischen Gesellschaft 24:395–416, pls. 8–11.
- GOSLINER, T. M. 1985. The aeolid nudibranch family Aeolidiidae (Gastropoda: Opisthobranchia) from tropical southern Africa. *Annals of the South African Museum* 95:233–267.
- KEMPE, S. 2002. Photo of "*Berghia verrucicornis*" from Florida. Available via Sea Slug Forum: <http://www.seaslugforum.net/find.cfm?id=6472>
- MARCUS, EV. 1977. An annotated checklist of the western Atlantic warm water opisthobranchs. *Journal of Molluscan Studies*, Supplement 4:1–23.
- MARCUS, ER. & EV. MARCUS. 1970. Opisthobranchs from Curaçao and faunistically related regions. *Studies on the fauna of Curaçao and other Caribbean Islands* 33:1–129.
- MARCUS, EV. & EV. MARCUS. 1967. Tropical American opisthobranchs. *Studies in Tropical Oceanography* 6:3–137, pl. 1.
- MILLER, M. C. 2001. Aeolid nudibranchs (Gastropoda: Opisthobranchia) of the family Aeolidiidae from New Zealand waters. *Journal of Natural History* 35:629–662.
- RUDMAN, W. B. 1982. The taxonomy and biology of further aeolidacean and arminacean nudibranch molluscs with symbiotic zooxanthellae. *Zoological Journal of the Linnean Society* 74:147–196.
- RUDMAN, W. B. 1990. *Protaeolidiella atra* Baba, 1955 and *Pleurolidia juliae* Burn, 1966; one species, two families (Nudibranchia). *Journal of Molluscan Studies* 56:505–514.
- THOMPSON, T. E. & G. H. BROWN. 1984. *Biology of Opisthobranch Molluscs*. Vol. 2. The Ray Society: London. 229 pp.